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Modern Concepts of Cardiovascular Disease

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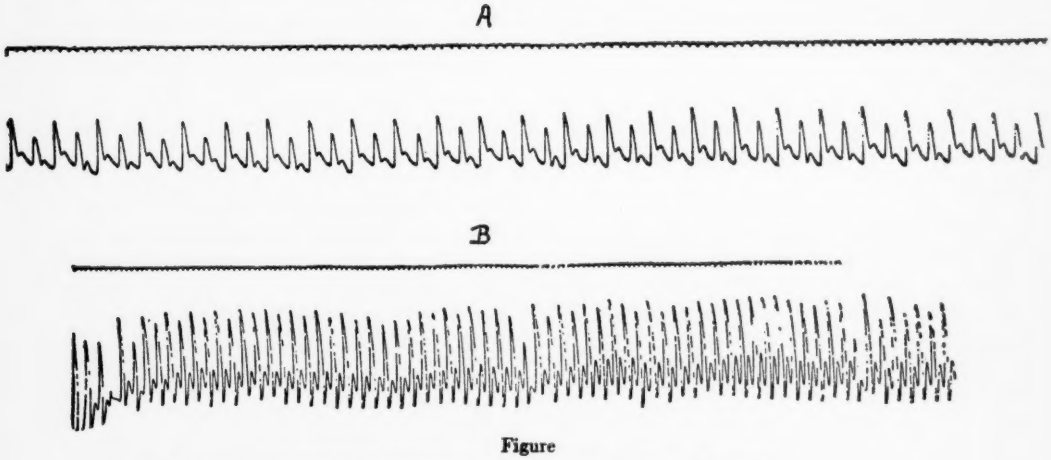
ALTERNATION OF THE PULSE — STILL A COMMON AND IMPORTANT CLINICAL CONDITION.

It is just as important for the medical profession to revive an interest in some important clinical finding which has been neglected as it is to learn of some new discovery. Such a finding is pulsus alternans, which although first recognized many years ago (Traube, 1872) was not accorded its actual significance as a serious sign until during the early years of this century (Mackenzie 1902, 1908; Wenckebach 1903) or as clinically common until 1915 (White). It is difficult to understand why it has been so neglected in practice or in teaching unless it is because we teachers ourselves have failed adequately to present it to our students, both graduate and undergraduate. It is time for us to try to correct this error. Probably our absorption in electrocardiography and all its ramifications and our relative neglect of graphic records of the mechanical activity of the heart and circulation play a role. Although ballistocardiography may as one of its more useful functions bring us back to a better recognition of the value of mechanical recording, it is not necessary to rely on this particular technic to discover the presence of pulsus alternans in any patient.

Definition. Alternation of the pulse consists of a regular variation of the fullness and pressure of alternate strokes of the arterial pulse during regular beating of the heart (Figure). Thus, smaller pulse strokes alternate with larger ones and the difference in systolic blood pressure varies from 1 up to 10 or 15 millimeters of mercury. Since respiration is accompanied by variations in blood pressure, it is wise in many cases to search for or to record pulsus alternans with the breath held for at least a few seconds. Pulsus alternans may be constant for hours or days at a time or it may be present for only a few minutes or indeed for but a few seconds after a premature beat. It may be marked in degree or moderate or slight, but it is always important. There is as a rule no accompanying alternation of the record of the electrical activity of the



Figure

A. Radial arteriogram showing constant pulsus alternans. Time = 0.2 second.

B. Arteriogram showing three premature beats followed each time by pulsus alternans for six to eight beats. Time = 0.2 second.

heart; very often the electrocardiogram of the patient who shows pulsus alternans is abnormal but only very rarely does it show any alternation of its complexes, a very different thing from the mechanical pulsus alternans per se.

Its Detection. Although graphic records of the arterial pulse, particularly in the arm (brachial or radial), can be employed to find alternation of the pulse, it can quite simply be looked for in the course of routine sphygmomanometry, particularly of course in the case of patients with considerable strain on the left ventricle as from severe chronic hypertension, aortic valve disease (stenosis or regurgitation), or myocardial infarction (past or present) where the cardiac rhythm is regular or disturbed only by premature beats. The pressure of air in the brachial cuff is maintained at or very close to the systolic level for some seconds with the patient holding his breath while the observer listens very carefully for a halving of the sounds of the pulse beats or watches the mercury column or dial needle for halving of the rate or feels every other pulse beat drop out at the wrist. In cases with much difference of the fullness or pressure of alternate pulse strokes (10 millimeters or more) pulsus alternans can be easily detected by simple palpation of the radial pulse, but one must be sure that in such cases the heart rhythm itself is regular and that one is not mistaking late premature beats (causing a pseudo-alternation) for true pulsus alternans. A bimanual method of detection of alternation of the pulse has been described with the substitution of a compressing thumb or finger over the artery at the elbow for the blood pressure cuff (White and Lunt, 1916), but this technic requires considerable experience and is more liable to subjective error. The pulsus alternans has been noted in ballistocardiography, but one does not require such a complicated technic for its detection. Finally, on occasion one can note with alternation of the pulse a corresponding alternation in the intensity of heart murmurs which are loud or of heart sounds which are accentuated.

Mechanism. Although in the past there has been much discussion as to the mechanism of alternation of the pulse, the general consensus of opinion now is that it is due to alternating strength of myocardial contractions excited by a uniform regularly recurring strength of electrical stimulation. The explanation of the reason for this alternation of strength of myocardial response is that some muscle fibers fail to respond at every beat due to prolongation of their refractory period. If there is a considerable disproportion between the numbers of fibers contracting at alternate beats, then pulsus alternans appears. Following the relatively long rest of the compensatory pause after a premature beat, a pulse stroke more vigorous than usual appears which in turn is followed by a smaller beat than usual with a gradual return to a more normal mechanism or at least to a more uniform degree of alternation. It occasionally happens that the smaller beats in pulsus alternans are slightly delayed at the wrist because they travel more slowly than the larger beats; this results in a slight bigeminal arrhythmia at the wrist while the heart beat is perfectly regular, but the smaller beats never come early as they do, of course, when there is a bigeminy due to "extrasystoles" (premature beats).*

Prevalence. Alternation of the pulse is, as it was in 1915, a common clinical condition in the U.S.A.; even though weak hearts are better treated nowadays than they were a generation ago, there are actually more patients with hypertension and myocardial infarction than there used to be, which fact is attributable in part at least to an increasing longevity of our population as a whole. Routine arteriography of 300 patients with heart disease in the wards of the Massachusetts General Hospital in the course of eight months as far back as 1914 and 1915 revealed 71 (24 per cent) who showed the pulsus alternans (White 1915).

Clinical Significance. Clinical experience of many workers before and since 1915 has shown that alternation of the pulse is one of the most useful signs that we possess of weakness of the left ventricle and that it may appear at times earlier than other important evidence of the same condition, such as diastolic gallop rhythm at the cardiac apex, or increasing accentuation of the pulmonic second sound, or dyspnea on effort or paroxysmally at night. Since it is in patients with systemic hypertension, or aortic valve disease, or myocardial infarcts, acute or chronic, that the left ventricle is likely gradually or even abruptly to weaken or to fail, it is in such cases that we should regularly look for pulsus alternans and treat it if we find it before more extensive evidence of graver heart failure appears. Thus, it is and should be more widely recognized as a valuable cardiovascular clue.

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* It should be noted that alternation of the first three beats after a post-extrasystolic pause is a normal finding. The post-extrasystolic alternation to be significant must extend for a longer time than those first three beats. Often it carries on for six, eight, or ten beats. Constant pulsus alternans is less common than that induced by the extrasystole (premature beat).

One qualification should be made about the serious clinical significance of alternation of the pulse. If it appears during very fast heart rates (e.g., 180 to 200 or more) in paroxysmal tachycardia and not at ordinary heart rates of 60 to 100, it may be considered as a sign of but temporary fatigue and not of serious prognostic import.

Treatment. Pulsus alternans demands respect and should be regarded and treated simply as a manifestation of left ventricular weakness. This means that, when we find it as a bona fide sign in the presence of strain on the left ventricle, the threat of left ventricular failure should be treated. The application of three measures of moderate degree may suffice, especially if effected early before congestion has become manifest: 1) limitation of factors of physical and nervous strain, 2) digitalis in moderate dosage, and 3) limitation of sodium intake to about a gram a day. These measures may suffice, but, if there is evidence of extensive heart failure with pulmonary or systemic congestion, more complete rest and diuretic drugs should also be employed. Pulsus alternans may disappear with recovery of myocardial reserve, but it is always serious when it appears at ordinary heart rates.

Alternation of the Pulmonary Arterial Blood Pressure. Before the days of cardiac catheterization it was impossible to detect or to record pulmonary arterial pulsus alternans. Since the introduction of this procedure, it has been noted on a number of occasions (personal communications, G. Myers, 1952, L. Dexter, 1952).

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The opinions and conclusions expressed herein are those of the author and do not necessarily represent the official views of the Scientific Council of the American Heart Association.

NOW AVAILABLE

The PROCEEDINGS OF THE ANNUAL MEETING, COUNCIL FOR HIGH BLOOD PRESSURE RESEARCH, 1952, are now available by purchase from the office of the American Heart Association, 44 East 23 Street, New York 10, N. Y.

The PROCEEDINGS are a paper-covered monograph of 113 pages, illustrated with tables, charts and figures. The content includes six scientific papers and six informal addresses to the lay audience. The scientific papers represent a review of recent original investigative work performed by the speakers and their associates. All are concerned with fundamental research which aims at increasing our knowledge and understanding of arteriosclerosis and high blood pressure.

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AMERICAN HEART ASSOCIATION FELLOWSHIPS AND RESEARCH GRANTS-IN-AID

Applications for Established Investigators and for Research Fellows for the fiscal year 1954-1955 must be received in the office of the Association not later than September 15, 1953.

Applications for Research Grants-In-Aid for 1954-1955 must be received not later than December 1, 1953.

Information booklets and application blanks may be obtained from the Medical Director.

ANNUAL MEETING

COUNCIL FOR HIGH BLOOD PRESSURE RESEARCH

AMERICAN HEART ASSOCIATION

Hotel Cleveland, Cleveland, Ohio

May 15 - 16, 1953

SCIENTIFIC SESSIONS — Friday, May 15

ENDOCRINES AND ELECTROLYTE AND WATER METABOLISM IN EXPERIMENTAL AND ESSENTIAL HYPERTENSION

MORNING SESSION

Edgar V. Allen, Chairman
Mayo Clinic, Rochester, Minnesota

1. THE ANTERIOR PITUITARY AND ADRENAL CORTEX IN EXPERIMENTAL HYPERTENSION
   R. W. Sevy, Ph.D., Department of Physiology, University of Illinois College of Medicine
2. THE ROLE OF RENIN IN EXPERIMENTAL HYPERTENSIVE VASCULAR DISEASES
   George C. Masson, M.D., Cleveland Clinic, Cleveland, Ohio
3. SALT-WATER BALANCE AND BLOOD PRESSURE
   Simon Rodbard, Ph.D., M.D., Department of Cardiovascular Research, Michael Reese Hospital, Chicago, Ill.

LUNCHEON

AFTERNOON SESSION

George E. Wakerlin, M.D., Chairman
University of Illinois College of Medicine, Department of Physiology
Chicago, Illinois

4. CHANGING PATTERNS OF SODIUM METABOLISM IN HYPERTENSION
   D. M. Green, M.D., Department of Medicine, University of Southern California, Los Angeles, California
5. ELECTROLYTE PARTICIPATION IN HUMAN HYPERTENSION
   George A. Perera, M.D., Department of Medicine, Columbia University, College of Physicians and Surgeons, New York City
6. PANEL DISCUSSION: EVALUATION OF METHODS OF TREATMENT OF ESSENTIAL HYPERTENSION
   Irvine H. Page, M.D., (Chairman), Robert H. Wilkins, M.D., Keith S. Grimson, M.D., Edgar V. Allen, M.D.,

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RECEPTION

ANNUAL DINNER

Speaker: Dr. George D. Stoddard
President, University of Illinois, Urbane, Illinois

"THE CONCEPT OF ACADEMIC FREEDOM RESTUDIED"

SESSION FOR LAY MEMBERS — Saturday, May 16, 1953

1. THE AMERICAN HEART ASSOCIATION AND THE COUNCIL FOR HIGH BLOOD PRESSURE RESEARCH
   Charles D. Marple, M.D., Medical Director, The American Heart Association
2. PANEL DISCUSSION: THE LAYMAN ASKS THE DOCTOR ABOUT HEART DISEASE
   Irving S. Wright, M.D., Chairman. Physician members: Dr. Keith S. Grimson, Dr. Edward Weiss, Dr. Caroline Thomas. Lay members: Mr. Keogh and Mr. Frank Joseph

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LUNCHEON

3. Brief Remarks by E. Cowles Andrus, M.D., President-Elect, American Heart Association